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FEBRUARY 1985 NUMBER 198

MONTHLY REPORT

ON THE NUCLEAR FUEL MARKET

NUEXCO

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

February 1985 No. 198

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PRICING
Natural Uranium and Conversion 1
Enriched Uranium and SWUs 1

CURRENT MARKET DATA
Nuexco Market Data Table 2
Prices Expressed in Selected Currencies 3
Recent Transactions 5
Supply and Demand Tables 6

BASIC CONSIDERATIONS
Primary Market Converters in the USA 11

RECENT DEVELOPMENTS
Australia 15
South Africa 16
United States 18

RAW MATERIALS
1984 US Uranium Activities 19

HISTORICAL MARKET DATA
Graph of Exchange Value and Transaction Value 22
Historical Exchange Value, Transaction Value and Conversion Value ... 23

GOVERNMENT STATISTICS
Australia and Canada 24
South Africa and United States 25

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To Our Readers

Nuexco announces the election of George White, Jr. as Chairman of the Board of Directors replacing Bob Wolcott, who resigned.

From its founding in 1968, Nuexco has benefited from sound leadership. Founders George White, Sr. and A. Payne Kibbe were innovators and builders, taking an idea and turning it into reality. During the past eight years, Bob Wolcott's vision developed Nuexco into an international, full-service nuclear fuel organization. Bob's contribution was enormous and enduring.

The new management looks forward to continuing this record of excellence.

* * *

Nuexco will host a hospitality suite during the Atomic Industrial Forum's Fuel Cycle Conference in New Orleans, Louisiana, March 12–15, at the Hyatt Regency. We look forward to seeing you there.

* * *

Nuexco's US offices will be closed on Monday, February 18 in honor of George Washington and Abraham Lincoln's birthdays. Our European office will be open for business as usual.

* * *

Included in this Report is a map to our offices in Stamford, Connecticut. We welcome customer visits.

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PRICING

NATURAL URANIUM AND SECONDARY MARKET CONVERSION

The **Exchange Value** as of January 31, 1985 is **$15.00** per pound U_3O_8, down $0.25 since last month. **Active supply** of natural uranium (U_3O_8 and UF_6) for spot or near-term delivery totals **4,180,000** pounds U_3O_8 or equivalent UF_6, up 540,000 pounds since last month. The corresponding figure for **active demand** is **1,265,000** pounds, up 15,000 pounds. The spot and near-term **supply-demand ratio** rose to **3.3:1.**

The *Current Market Data* section of this Report lists two uranium sales transactions, involving a total of approximately 500,000 pounds equivalent U_3O_8. One of the transactions reported this month involved low-enriched uranium, both involved deliveries before 1986, and one met the criteria for inclusion in the current Transaction Value calculation.

The **Transaction Value** as of January 31, 1985 is **$16.20** per pound U_3O_8, up $0.30 since last month. The current Transaction Value includes 14 transactions involving a total of 2.1 million pounds U_3O_8 or equivalent UF_6 and covers a period of 7 months. The Transaction Value rose as a result of dropping from the calculation June data, which included a transaction for a large quantity at a low price.

The **Loan Use Charge Rate** as of January 31, 1985 is **6 percent** per annum, unchanged since last month in a dormant market.

* * *

The Exchange Value declined for the fourth month in a row as the market for natural uranium concentrates continued to weaken. At $15.00, it has reached its lowest level since December 31, 1974. Buyers continue to hold out for the best possible terms, keeping market activity at a minimum and applying significant downward pressure on the Exchange Value. The buyer and seller indifference level, or that price range in which transactions may be completed between buyers that are willing but not pressured to buy and sellers that are willing but not forced to sell, has widened over the past several months. However, Nuexco has seen some indications of late that the gap might be narrowing; some buyers seem to be preparing to act as though they believe the market is approaching a low price plateau.

Several offers hovered below the $15.00 level, but certain contingencies applied which rendered them unfeasible. One seller chose not to sell immediately, and other opportunities involved quantities too small to be deemed significant. The typical quantity desired by buyers is something approximately equal to one reload. Quantities less than that need to be discounted substantially to overcome the buyers' reluctance to piece together several small lots to acquire the desired quantity. Substantial quantities of material remain available, both as UF_6 and as concentrates, so downward pressure on market prices continues.

* * *

The **Conversion Value** is **$1.00** per pound U in UF_6, up $0.20 since last month. One secondary market conversion transaction is reported, involving approximately 500,000 pounds U in UF_6. Active supply of secondary market conversion services for delivery within three years disappeared as the lone supplier withdrew from the market. Furthermore, one potential buyer for a large quantity has given indications of willingness to pay approximately $1.00 per pound U as UF_6 for conversion services on the secondary market. Active secondary market demand for conversion amounts to 760,000 pounds U in UF_6.

ENRICHED URANIUM AND SWUS

The Nuexco **SWU Values** as of January 31, 1985 are:

1. For **DOE origin,** a tails assay of 0.30 weight-percent U^{235}, and certifiable as excess:
   a. For FY85 delivery, $112 per SWU, unchanged;
   b. For FY86 delivery, $15 discount from the USEC base price on delivery, unchanged;
2. For **other** SWUs (includes DOE origin SWUs not certifiable as excess and non-DOE origin SWUs):
   a. For delivery in calendar year 1985, $80 per SWU, unchanged;
   b. For delivery in calendar year 1986, $90 per SWU, unchanged.

Two secondary market SWU transactions are reported, involving approximately 100,000 SWUs. One of the transactions involved low-enriched uranium.

* * *

SWU Values were unchanged this month as the lack of activity precluded a noticeable change in market prices. The market for DOE SWUs and FY85 delivery should remain open but inactive through February, until DOE announces new FY86 prices. Activity in the FY85 market has been very slow, and only a few sellers are still active. One new buyer, possibly the last FY85 SWU buyer, entered the market in January. The number of buyers interested in DOE SWUs for FY86 delivery is increasing, and they are preparing to enter the market following the DOE announcement. The timing for secondary market purchases is awkward now, because the absence of firm DOE prices for FY86 SWU makes economic comparisons difficult.

The market for SWUs other than DOE certifiable is almost dormant. Most utilities have filled all requirements until 1987, at which point the USEC allows many to fulfill 30 percent of requirements. Consequently, demand in Europe and the USA is very low. European buyers, however, are beginning to show more interest in long-term SWU purchases, most for 1987 and beyond.

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CURRENT MARKET DATA

January 31, 1985	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$15.00**/lb. U_3O_8	4,180	1,265
CONVERSION VALUE	**$1.00**/lb. U in UF_6	0	760
SWU VALUES			
DOE origin, certifiable as excess, 0.3 tails assay			
FY85 delivery	**$112**/SWU		
FY86 delivery	**$15** discount/SWU		
Other SWUs (non-DOE or non-certifiable)			
calendar year 1985 delivery	**$80**/SWU		
calendar year 1986 delivery	**$90**/SWU		
LOAN USE CHARGE RATE	6%/annum	0	0

TRANSACTION VALUE	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
	16.20	2.1	14	7

[1]Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
3. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
4. The **Loan Use Charge Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
5. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
   a. Transactions closed within the previous three-month period for which delivery is scheduled within one year of the transaction date;
   b. At least ten transactions;
   c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.

   The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
   a. Data from recently completed transactions.
   b. Data from pending transactions.
   c. Firm bids to buy or borrow, and firm offers to sell or lend.
   d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed a willingness to offer, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not considered in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the DOE SWU Values, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight-percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminant variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)	This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)
Australia (dollar)	18.38	18.37	22.33	47.78	47.77	58.06
Belgium (comm. franc)	949.37	960.33	1,177	2,468	2,497	3,061
Canada (dollar)	19.91	20.13	25.60	51.77	52.34	66.54
Finland (markka)	99.40	99.48	121.81	258.43	258.62	316.67
France (franc)	145.07	147.20	176.42	377.14	382.69	458.65
FRG (mark)	47.53	47.99	57.65	123.56	124.75	149.87
Italy (lira)	29,240	29,480	35,121	76,017	76,641	91,306
Japan (yen)	3,817	3,814	4,809	9,923	9,917	12,502
Netherlands (guilder)	53.74	54.08	64.83	139.72	140.59	168.55
South Africa (rand)	29.56	29.99	25.98	76.84	77.97	67.55
Spain (peseta)	2,628	2,638	3,250	6,832	6,857	8,450
Sweden (krona)	135.62	136.53	167.76	352.59	354.94	436.13
Switzerland (franc)	40.11	39.54	45.97	104.27	102.79	119.52
UK (pound)	13.27	13.10	14.56	34.50	34.05	37.87
US (dollar)	15.00	15.25	20.50	39.00	39.65	53.30

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)	This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)
Australia (dollar)	19.85	19.16	25.11	51.60	49.80	65.28
Belgium (comm. franc)	1,025	1,001	1,324	2,666	2,603	3,442
Canada (dollar)	21.51	20.99	28.78	55.91	54.57	74.82
Finland (markka)	107.36	103.72	136.96	279.10	269.64	356.06
France (franc)	156.67	153.47	198.36	407.31	399.00	515.70
FRG (mark)	51.33	50.03	64.82	133.45	130.07	168.52
Italy (lira)	31,579	30,737	39,489	82,098	79,908	102,664
Japan (yen)	4,122	3,977	5,407	10,717	10,339	14,057
Netherlands (guilder)	58.04	56.38	72.90	150.90	146.58	189.52
South Africa (rand)	31.92	31.27	29.21	82.99	81.29	75.95
Spain (peseta)	2,838	2,750	3,655	7,378	7,149	9,501
Sweden (krona)	146.47	142.35	188.63	380.80	370.07	490.38
Switzerland (franc)	43.32	41.22	51.69	112.61	107.17	134.39
UK (pound)	14.33	13.65	16.38	37.25	35.50	42.58
US (dollar)	16.20	15.90	23.05	42.12	41.34	59.92

[1] Calculated using currency exchange rates published in the *Wall Street Journal* on January 31, 1985.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6			per kg. U as UF_6		
	This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)	This Month (Jan. 31, 1985)	Last Month (Dec. 31, 1984)	12 Months Ago (Jan. 31, 1984)
Australia (dollar)	1.23	0.96	0.65	2.70	2.13	1.44
Belgium (comm. franc)	63.29	50.38	34.46	139.53	111.06	75.98
Canada (dollar)	1.33	1.06	0.75	2.93	2.33	1.65
Finland (markka)	6.63	5.22	3.57	14.61	11.50	7.86
France (franc)	9.67	7.72	5.16	21.32	17.02	11.38
FRG (mark)	3.17	2.52	1.69	6.99	5.55	3.72
Italy (lira)	1,949	1,546	1,028	4,298	3,409	2,266
Japan (yen)	254.45	200.10	140.75	560.97	441.14	310.29
Netherlands (guilder)	3.58	2.84	1.90	7.90	6.25	4.18
South Africa (rand)	1.97	1.57	0.76	4.34	3.47	1.68
Spain (peseta)	175.19	138.36	95.13	386.23	305.03	209.73
Sweden (krona)	9.04	7.16	4.91	19.93	15.79	10.82
Switzerland (franc)	2.67	2.07	1.35	5.89	4.57	2.97
UK (pound)	0.88	0.69	0.43	1.95	1.51	0.94
US (dollar)	1.00	0.80	0.60	2.20	1.76	1.32

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY85 (January 31, 1985)	Non-DOE SWU 1985 delivery (January 31, 1985)	Non-DOE SWU 1986 delivery (January 31, 1985)
Australia (dollar)	137.22	98.02	110.27
Belgium (comm. franc)	7,089	5,063	5,696
Canada (dollar)	148.68	106.20	119.47
Finland (markka)	742.21	530.15	596.42
France (franc)	1,083	773.69	870.41
FRG (mark)	354.88	253.49	285.17
Italy (lira)	218,324	155,945	175,439
Japan (yen)	28,499	20,356	22,901
Netherlands (guilder)	401.29	286.64	322.47
South Africa (rand)	220.69	157.64	177.34
Spain (peseta)	19,622	14,015	15,767
Sweden (krona)	1,013	723.33	813.74
Switzerland (franc)	299.47	213.90	240.64
UK (pound)	99.07	70.77	79.61
US (dollar)	112.00	80.00	90.00

[1]Calculated using currency exchange rates published in the *Wall Street Journal* on January 31, 1985.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
3291A	1985	301-600	R[2]; see remarks	European Utility	US Fabricator	LEU (assumes 0.3% tails assay). Not an arm's length transaction.
3269	1985	101-300	103	US Producer	US Utility	

[1]Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2]The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
3288	1985	300-601	100	US Utility	European Utility	

Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller Group	Buyer Group	SWU Origin	Remarks
3291B	1985	50-100	R[5]	European Utility	US Fabricator	R[5]	LEU (assumes 0.3% tails assay). Not an arm's length transaction.
3264	1985	less than 50	91	R[5]	European Utility	DOE	Occurred in late 1984.

[1]Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2]If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.
[3]Price is not normalized to 0.30% tails assay.
[4]Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the *discounts*, not the ratio of the prices.
[5]The notation *R* means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

URANIUM SUPPLY
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1575	500	500 per year	
1860	400	1,500 per year	
2038	1,000	1,000 per year	UF_6
2134*	220	220 per year	1986-87
2236*	200	200 per year	1986-89
2288A	40	—	
2288B	295	—	UF_6
2389*	200	—	
2392	35	—	UF_6
2499	15	—	
2516	200	—	
2538*	35	—	
2538A*	130	—	UF_6
2565	400	—	
2569	200	—	
2584*	300	—	
2603*	10	—	
2263	—	500 per year	1985-90
2625	—	300 per year	1988-97
2657*	—	980	1986; UF_6
TOTAL:	4,180		
INACTIVE			
2191	125	—	UF_6
2275	150	—	
2335	275	—	
2336	250	250 per year	1985-94
2495	130	—	UF_6
2509	1,200	1,600	UF_6
2553	300	—	
2664*	250	250 per year	UF_6
0564	—	1,000 per year	1985-90
2271	—	500 per year	1985-88
2297	—	200 per year	1986-89
2326	—	1,000 per year	1989-91
2368	—	250 per year	1987-90
2514	—	1,000 per year	
2574	—	500	UF_6
TOTAL:	2,680		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2473.

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CURRENT MARKET DATA

URANIUM DEMAND
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2457A*	130	—	
2548	300	—	
2590	475	—	U_3O_8 or UF_6
2636*	200	—	
2690*	160	—	
2217	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540	—	400 per year	1989-94
TOTAL:	1,265		
INACTIVE			
2329	500	—	1985
2576	20	—	UF_6
2638*	350		UF_6
1999	—	50 per year	1986-90
2244	—	350 per year	1987 on
2414*	—	365	1987-88
2457B*	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
2674*	—	1,000	
TOTAL:	870		

*New or revised since last month.
[1] Measured from the date of this Report.
[2] For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2533, 2419B.

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CURRENT MARKET DATA

CONVERSION SUPPLY AND DEMAND
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
TOTAL:	0		
INACTIVE			
2051	1,000	—	
2438	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	2,100		
Inquiries to Purchase:			
ACTIVE			
2602*	460	—	
2638A*	300	—	
TOTAL:	760		
INACTIVE			
2644*	—	475	1987 on
2587*	285	—	
TOTAL:	285		

*New or revised since last month.
[1]Measured from the date of this Report.
Projects removed since last month: 2141.

LOAN SUPPLY AND DEMAND
(January 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
TOTAL:	6,050		

*New or revised since last month.
[1]Measured from the date of this Report.

No inquiries to borrow this month.

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URANIUM DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2419*	130	—	UF_6
2548*	290	—	
2574B*	640	—	UF_6
2590*	75	—	U_3O_8 or UF_6
2636	100	—	
2659*	250	—	
2661	260	260 per year	1986-87
2674*	800	—	
2676*	100	—	UF_6
2690	160	—	
2995*	1,250	—	UF_6
2217	—	1,000 per year	1989-95
2442	—	4,000	1986-95
2507	—	600	1987-89
2540	—	400 per year	1989-94
2611*	—	130 per year	1987-88
2681*	—	1,000 per year	1987-88
2694*	—	625	1987; UF_6
TOTAL:	4,055		
INACTIVE			
2576	20	—	UF_6
2244	—	350 per year	1987 on
2414	—	365	1987-88
2457B	—	650	1987
2586	—	300	1987
2643	—	150 per year	1987 on
TOTAL:	20		

*New or revised since last month.

[1]Measured from the date of this Report.

[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

Projects removed since last month: 1999, 2329.

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CURRENT MARKET DATA

LOAN SUPPLY AND DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
INACTIVE			
1938	2,000	—	UF_6
2128	700	—	
2139	2,000	—	
2469A	800	—	
2483	550	—	
2667	800	—	
TOTAL:	6,850		

CONVERSION SUPPLY AND DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
2051*	110	—	
TOTAL:	110		
INACTIVE			
2438	500	250 per year	1986-87
2511	600	700	1986-90
TOTAL:	1,100		
Inquiries to Purchase:			
ACTIVE			
2419A	55	—	
2602	200	—	
2617*	—	275	1986-91
TOTAL:	255		
INACTIVE			
2529	225	—	
2587*	70	—	
2644	—	475	1987 on
TOTAL:	295		

*New or revised since last month.
[1]Measured from the date of this Report.
Projects removed since last month: None.

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SWU SUPPLY
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
2100	150	100 per year	
2359*	—	200	
2624	100	—	
2631	150	—	
2633B	330	—	
2664	150	—	
2285	—	300	
2513	—	25	1986
2517*	—	155	1986-89
2571	—	55	1987
TOTAL:	880		
INACTIVE			
2164*	20	—	
2378	—	120	1988
2510	—	50	
2652	—	25	1986
TOTAL:	20		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2583, 2657A, 2689.

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CURRENT MARKET DATA

SWU DEMAND
(March 31, 1985)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2655	10	—	
2400*	—	150	1987-90
2519	—	30 per year	1987 on
2578	—	100	1986
2653	—	100	1986-90
2658	—	5	1986
TOTAL:	10		
INACTIVE			
2543	25	25	1986
2585*	—	40	1986
2500*	—	170	1988
2512	—	15 per year	1987 on
2595	—	50	1986
2693*	—	100 per year	1989-90
TOTAL:	25		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes SWUs deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2665, 2669.

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PRIVATIZATION AND THE COMPETITIVENESS OF US ENRICHMENT SERVICES

by Dr. Karl P. Cohen

The following is a presentation made by Dr. Karl Cohen at the Atomic Industrial Forum's Fuel Cycle Conference in New Orleans on March 13, 1985. Dr. Cohen's distinguished record in the field of nuclear energy includes major contributions to the theory of isotope separation and the methodology of gaseous diffusion and centrifugal separation. He received the 1979 Chemical Pioneer Award of the American Institute of Chemists for his theory of gas centrifuges. This presentation is reprinted by permission.

Introduction

In 1973, the US nuclear power program was projected to attain 1,200 GWe by the turn of the century. It is now projected to reach only 110 GWe (Table 1). The uranium enrichment industry, which presently has little other purpose than to supply fuel for nuclear power plants, must obviously be profoundly affected. We are not looking here at minor changes, which might be accommodated by a change in style of doing business, however desirable that might be. We are looking at order-of-magnitude changes. We are looking at an earthquake. What is called for is a complete reappraisal of the fundamental purposes and structure of the US uranium enrichment program, including our objectives in serving the domestic and international uranium enrichment markets by a government-managed enterprise.

Table 1

US ENRICHMENT ENTERPRISE CAPACITIES[1]
(Millions of SWUs per year)

	1973	1985
Capacity	17	27
Planned Capacity	10	13
Production	10	10
Projected domestic market in the year 2000	100	12
Projected off-shore market in the year 2000	100	30
Off-shore market share in percent	100	37

[1] Free World only.

You will have recognized that this call for a reappraisal of the goals of our enrichment program bears some resemblance to the conclusion of the Comptroller General in his recent report to former Congressman Ottinger on the new Utility Services Contract. There are however significant differences. I do not consider it *a priori* evident that serving the international market should be a primary objective, that pricing by itself will be sufficient to achieve it.

At present, fuel accounts for 20 to 30 percent of the generating cost of nuclear power (the lower value is in the USA, where capital costs are high). About one-third of this cost comes from the enrichment process. Thus enrichment contributes only 7 to 10 percent of nuclear power costs, while capital charges account for 50 to 70 percent. To a plant owner, assurance of supply of enriched uranium has five to ten times the economic weight as the price of enrichment itself. But the supply of enriched uranium from the USA is conditional on political concessions which are not only burdensome but subject to unilateral change. This has made the USA the enrichment supplier of last resort in the only market which still has vitality—the off-shore market. To breathe new life into the US enrichment enterprise we shall have to look at more than the technology, and more than the price. We shall have to examine some of the unwanted side-effects of that sacred cow of American politics, the nuclear non-proliferation policy.

The parallel between the difficulties of the enrichment enterprise and the difficulties of the US nuclear power industry has certainly not escaped this audience. The recent Forbes article concludes that a reform of our institutions, more than of our technology, is the prerequisite for a rebirth of the nuclear option in the US. Similarly, important as technology is in uranium enrichment, a purely technological fix is not available to us. We have to take into account the management of the enterprise, and the policies and institutions which constrain it.

Let me refer you back for a moment to the data in Table 1. It is clear that a pricing formula which might be perfectly reasonable in 1973 could be wildly inappropriate in 1985. The GAO letter, and the Congressional inquiry which precipitated it, illustrate, if further illustration were necessary, the intrinsic difficulties of government management of uranium enrichment, and the desirability of serious consideration of privatization.

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Objectives

Table 2 presents a number of possible objectives for the enrichment enterprise. At first glance, it might seem that all the objectives are desirable, and that all can be attained. However, this is only possible in a monopoly situation. For example, the virtue of the first objective, assuring domestic fuel supply, seems almost self-evident. It is a parallel to the requirement of the Atomic Energy Act that a viable domestic uranium industry be maintained. But other countries, many of whom have a far greater percentage commitment to nuclear electricity than we do, are likely to think the same way. If we are prepared to pay more for uranium from low-grade American ore, will they not be willing to buy enrichment services from their local enrichers, even at a premium? Assurance of supply by supporting domestic producers is a doctrine which, if adopted universally, is likely to frustrate the achievement of Objective 4. The continued interest in new enrichment programs—for example, Japan, Brazil, South Africa and Argentina—despite the world glut of separation capacity and overhanging enrichment inventories, points in this direction.

Table 2

POSSIBLE ENRICHMENT ENTERPRISE OBJECTIVES

1. Assure fuel supply for domestic reactors.
2. Maintain capability to produce HEU for military.
3. Maximize off-shore sales of reactor equipment by advantageous terms for enriched fuel.
4. Maximize off-shore market by low prices to support US non-proliferation policy.
5. Maximize market share by low prices to increase cash return.
6. Maximize profit.

The second objective introduces two new questions. The first is whether the production of HEU should ever be privatized. This might be resolved by splitting out the high enrichment cascade from the rest of the plant and retaining it as a separate, government-owned entity. This leads naturally to the issue of whether a privatized enrichment enterprise should be in one piece or split into several. Arguing for one piece are the extraordinarily high capital requirements of enrichment plants, capital which could be raised on most favorable terms by a regulated monopoly. A regulated monopoly could write long-term exclusive contracts, also helpful in raising capital, without running afoul of the anti-trust laws. Arguing for several pieces are the benefits of competition, and the relative ease of introduction of new technology.

The last four objectives are somewhat inconsistent, since it is unlikely that one can maximize them simultaneously. During the period of American monopoly of uranium enrichment facilities, maximizing off-shore sales of nuclear reactors and supporting US non-proliferation policy were not obviously incompatible. However, American supply of enriched uranium was accompanied by restrictions on use or disposal of the spent fuel. These were not acceptable to the Europeans, and were a determining factor in our ultimate loss of the enrichment monopoly. The passage of the Nuclear Non-Proliferation Act of 1978, which contains clauses encouraging the use of solar and renewable energy rather than nuclear power, and discouraging the reprocessing and recycling of spent nuclear fuel, has effectively eliminated the third objective. Nobody can possibly believe that the object of the coalition that passed the Act was to foster nuclear power in any country. The present policy of DOE is a combination of objectives 4 and 5, namely, maximizing the market share by lowering prices, to increase cash flow and also to support US non-proliferation policy. Increasing cash flow is the driving force. Supporting non-proliferation policy is a constraint. It should be noted that the erosion of the US off-shore market share began *before* the rise of the dollar, while we still had price leadership. Thus the policy seems unlikely to succeed without ruinous price concessions. It reminds me of the legendary wholesaler who lost on each sale, but made it up on volume.

The last objective is maximizing profit. Unless this is taken as the primary objective, privatization is only a slogan, not a real option. Maximizing profit might require a very different approach to the market. The approach might be to set terms and prices to suit the domestic market (where there is a preference for US supply), rather than to obtain the maximum off-shore market; to shut down and write off excessive and high cost production facilities; to evaluate technical options on a total cost and not a forward cost basis; to control costs by eliminating excessive contractors and excessive personnel; and to share the benefits of lower cost advanced technologies by improving profits as well as lowering prices. Such an approach would require unified marketing but could in the long run accommodate competitive producing units.

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Further Observations on Privatization

The current invitation of DOE for private industry to invest in the AGC and the AVLIS processes is directed at solving DOE's immediate financial problem without altering the Department's management of the projects. The capital intensity of uranium enrichment is unusually great. The government is in fact the appropriate source of capital or credit. The financial problem has arisen by a combination of delayed management response to the rapidly changing market conditions, and hostile Congressional oversight. Industry has no place volunteering to be the lender of last resort, merely because ideologues in and out of Congress impose unreasonable constraints on the finances and the policies of the enrichment enterprise.

What should be privatized is not the *financing*, but the *management* of the uranium enrichment enterprise. This Administration, (and previous ones as well), have favored this procedure for organizations as diverse as the Post Office, the Federal National Mortgage Association, and the Tennessee Valley Authority.

The last major effort at privatization of enrichment peaked in the period 1975-76 with the debate on (and defeat of) the Nuclear Fuel Assurance Bill. At the time, the late Craig Hosmer suggested that a government corporation would be a more acceptable alternative. I believe his idea has considerable merit. Such a corporation would isolate the enrichment enterprise from the annual Congressional budget process. It could offer bonds like TVA, and allow investment to be offered based on the needs, and supported by the revenues, of the enrichment business alone. The Board of Directors should be larger than that of TVA, and include outside directors who would represent the insights and interests of other segments of the nuclear industry, notably (but not exclusively) the utilities and the uranium miners.

To establish such a corporation, new legislation would be necessary. The debate on such legislation would furnish an opportunity to forge a consensus on the *objectives* as well as the *structure* of the corporation, and might be an important step in the public education needed for a rebirth of the nuclear industry.

The Economic Competition

Economic comparisons between plants in different countries are very hazardous. Plant capital costs, even if fully reported, are in different currencies. Inflation and interest during construction depend on local circumstances and schedules. They are not strictly comparable, and they are seldom fully reported. The capital charge rate applied depends on details of the financing, generally considered a commercial secret, and the local accounting rules. In the US enrichment plants, the capital charge is the imputed interest rate, which rises and falls from year to year with general interest rates. Inventories of natural and enriched uranium may be large or small, depending on policy and history. The inventories may be valued at acquisition costs (themselves variable), or otherwise. The cost of maintaining inventory may be calculated in the same way as the cost of fixed capital, or differently. Finally the utilization factor—the fraction of the plant capacity which is actually used—is an overall divisor into the capital charges.

Of the operating costs, labor rates and productivity vary from one country to the next. In the gaseous diffusion process, the pricing formulae reveal that half the price is proportional to the cost of power. The power costs depend on contract arrangements with particular suppliers, whose demand and energy charges are not uniform. While these are published in the US, they are not readily available elsewhere. Plant managers, depending on production requirements, may schedule operations at off-peak hours, thus obtaining better rates. Thus, Eurodif plans to operate only during the seven summer months when power costs are lower.

Translating costs from one currency to another introduces another uncontrollable factor. Over the past four years the dollar has risen approximately 40 percent against a basket of 15 foreign currencies, and even more spectacularly—150 percent—against the French franc. Most observers believe the dollar is at a cyclical high and will come down. I do not know of any accepted economic theory which defines "equilibrium" exchange rates, but it seems unlikely that the dollar will fall below its 1980-81 values, when it was at a cyclical low. In most of the economic comparisons, I use the low values, to show that our present lack of cost and price leadership will not disappear with the next exchange rate fluctuation.

It is clear that the long-range competitiveness of the US Gaseous Diffusion Plant is not determined by the temporary embarrassment of an unfortunate power contract which imposes high demand charges for power not used. Just as clearly, it cannot be measured by the price of a particular block of kWh purchased over a summer weekend. We must bring in more fundamental considerations. What appears to be really relevant is the average bus-bar cost of electric energy to all US industry. We must face the fact that the US utility industry has fallen behind the rest of the world in its ability to build new capacity economi-

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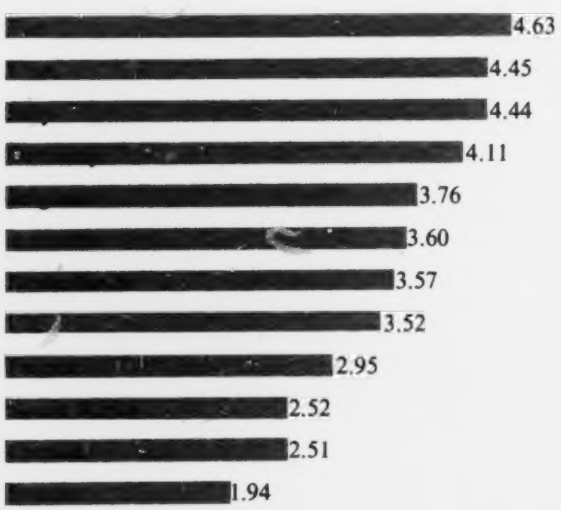
ANALYSIS & COMMENTARY

cally. The capital costs of any new generating capacity are so high that we are witnessing a virtual moratorium on new plant construction. In a situation where new capacity costs more than installed capacity, lower prices to one industry mean higher prices and less competitiveness for another.

When push comes to shove, the ultimate measure of competitiveness of gaseous diffusion plants will be their out-of-pocket costs for additional SWUs. Figure 1 shows the situation as of April 1, 1984. Eurodif uses about 13% more kWhs per SWU than our plants, but our kWhs cost about 50 percent more than theirs. Table 3 looks further ahead to 1990. Notice that the French total power cost is projected to be two-thirds of ours and their energy cost one-half, using 1981 exchange rates. In 1981, the franc was about 20 cents. The bottom line is my speculation on the generating costs of a Siberian hydro plant which would be feeding current to a Russian diffusion plant. The conclusion seems inescapable that our superior diffusion technology is not enough to compensate for the difficulties of our power industry. We will not regain price leadership with an energy-intensive process.

Figure 1

WORLD INDUSTRIAL AND COMMERCIAL ELECTRICITY PRICES AS OF APRIL 1, 1984[1]
(Pence per kilowatt-hour)



[1]This figure is a reproduction of a figure presented in *Nuclear Europe*, Volume 10, October 1984, in an article by G. Ekberg, L. Fogelstrom and L. Gustafsson entitled "Nuclear Power Production in Sweden." Source: National Utility Services.

Table 3

LEVELIZED DISCOUNTED GENERATION COSTS
1990 PLANTS
(Jan. 1, 1981 cents per kWh)
(discount rate 5 percent)

Country	Capital	O & M	Fuel	Total
France (Nuclear)	1.02	0.36	0.69	2.07
USA (Coal)	1.03	0.37	1.52	2.92
USSR (Hydro)	?	?	0.00	1.00

Source: OECD, September 9, 1983.

Table 4 gives the approximate status of the competition in centrifuge technology, given in 1980 dollars. In addition to the difficulties mentioned above of comparing costs in different countries, note that none of these plants has actually been completed and operated. Prudence suggests a further reserve about what the numbers will be when the plants are on-line. However, Urenco has already built and operated some plants, and half the Portsmouth plant is already in existence, so the rankings have some credibility. Let me remind you again that these rankings are in 1980 dollars. Since then, the mark has dropped from 50 cents to 30 cents. At present exchange rates, the German and American technologies would appear to be neck-in-neck.

I have not prepared a table on the economics of the AVLIS process, since I have no confidence in my ability to project the capital and operating costs of the process when (and if) it is realized. Since many other nations are,

Table 4

THE CENTRIFUGE COMPETITION
(1980 dollars)

Technology	Capital $ per SWU per year	Power $ per SWU	O & M $ per SWU
US Set III	660	2	22
Urenco 1985[1]	500	2	11
US Set V	330	2	11

[1]Gronau, FRG.

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as they should be, interested in laser isotope separation, I do not doubt that we shall face strong competition in this technology as well.

Conclusions

It is time for us to discard the notion, which is a holdover from the years of American monopoly of uranium enrichment supply, that we have guaranteed technical superiority in all branches of isotope separation; and that this technical and economic superiority is so great that we can impose terms and conditions on our enrichment supply without regard to the preferences of our customers, or the alternatives available to them. We do have, indeed, the largest surplus enrichment capacity in the world, burdened with the highest energy costs. It is not plain why this is an advantage.

The last addition to the US gaseous diffusion plants increased the capacity over the years 1974 to 1982 by 10.1 million SWU per year, at a cost of 1.5 billion nominal dollars. Over roughly the same period, Eurodif built a green field plant of 10.8 million SWU per year, at a cost of 16 billion francs. No matter how one translates from francs to dollars, this is a respectable achievement. The French have developed a chemical exchange process for uranium enrichment, which we were unable to do. The inventor of the basic design of the modern gas centrifuge is still consulting for Urenco. This is not a time for complacency, still less for cutting back on research and development, as I was horrified to see embodied in the justification furnished for our new contract price of $135/SWU.

We also need, not *business-like* management, but *business management,* free to choose and fight for realistic goals, and free to make the hard decisions which will be required to implement them. In the long run, privatization will probably be required to achieve our objectives. Establishment of a government corporation is the essential first step.

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RECENT DEVELOPMENTS

GREECE

The Greek Institute of Geological and Mining Research (IGME) has announced the existence of a uranium production pilot plant in Paranesti, in northern Greece. The plant's construction was funded jointly by the Greek government and the European Economic Commission (EEC), and has been in operation since November 1984. IGME conducts exploration in the area and operates the pilot plant.

IGME began extensive survey operations at Paranesti in 1980, although the existence of uranium deposits in the area was documented in the early 1960s. IGME has estimated reserves at several million tonnes, and plans to issue a revised reserves estimate in the coming months. While the government's official energy plan does not mention nuclear power, the Energy Minister stated that known uranium reserves are capable of providing fuel for a 600-MWe reactor for 35 years, and the issue was now under study.

JAPAN

Kansai Electric Power Co. recently completed the planning phase for two additional 1,180-MWe PWRs, Ohi Units 3 and 4, to be located at the current Ohi site. In its first approval action for new nuclear generation facilities in 22 months, the government's Electric Power Resources Development Coordination Council (EPRDCC) granted approval to plans for the two units and officially recognized them as projects (see Report 188, April 1984, for Japan's nuclear plant licensing procedure). Kansai Electric is now prepared to submit plant designs and safety analysis for construction/operating license approvals. Commercial operation dates for the two units are scheduled for 1991 and 1992, respectively.

Similar EPRDCC approval is expected shortly for Tokyo Electric Power's Kashiwazaki Units 3 and 4, each 1,100-MWe BWRs, with commercial operation scheduled for 1993 and 1994 respectively. Chubu Electric also announced it was planning its next plant, Hamaoka Unit 4, which probably will be an 1,100-MWe BWR. A commercial operation date for the plant has not been established.

* * *

Plans for location of new enrichment, reprocessing and low-level waste storage facilities at a common location are proceeding as scheduled (see Report 193, September 1984). The governor of Aomori Prefecture, the proposed location of the facilities, announced his approval of the projects, subject to final endorsement by the prefectural assembly, expected by the end of March.

The Power Reactor and Nuclear Fuel Development Company (PNC), which developed centrifuge technology for the planned enrichment facility, also will provide reprocessing technology for the planned reprocessing facility, to be operated by Japan Nuclear Fuel Services (JNFS). PNC, under a national development program, has built and operated since 1980 an 0.7-ton-per-day demonstration reprocessing plant at Tokai Mura. The plant sustained a series of dissolver failures in 1982 and 1983, and has operated only intermittently. Dissolver repair and replacement programs recently were completed. The plant now is scheduled to return to normal operations in April. An initial goal to process 70 tons of spent LWR fuel from domestic reactors has been established. Several other developments in plans for recycling plutonium and depleted uranium have occurred in recent months:

1. Japan Atomic Power Company (JAPC) has received license approval to load two mixed-oxide fuel bundles into Tsuruga Unit 1, a 357-MWe BWR, for test purposes. In a separate study, government agencies have suggested that the utilities should plan to load mixed-oxide fuel into ten LWR units by 2000.
2. PNC successfully performed test enrichment of depleted uranium produced by its Tokai Mura reprocessing facility. PNC is proposing that the utilities support construction of a facility to re-enrich 20 to 100 tons of depleted uranium annually to demonstrate the technology.
3. PNC recently announced new cost estimates for its often-delayed, 280-MWe demonstration FBR now scheduled for operation in the mid-1990s. The current estimate exceeds $2.3 billion, a 50-percent increase from the 1979 estimate.

* * *

Japanese utilities have concluded annual price negotiations for deliveries under long-term uranium supply contracts with African and European suppliers. The utilities agreed to pay approximately $32 per pound U_3O_8 for 1986 deliveries (fiscal year ending March 31, 1986), a reduction of $1.00 to $1.50 relative to the price paid for 1985 deliveries.

The annual price negotiations are influenced greatly by developments in the spot and near-term prices over the previous year, as opposed to the months immediately preceding the negotiations. Thus, the spot/near-term prices paid in May or June 1984, when the Exchange Value was $17.75, probably had as much influence in determining FY86 long-term prices as did spot/near-term prices paid

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in February or March 1984, when the Exchange Value was $15.00.

The downward pricing trend for long-term price agreements has slowed considerably in the last few years, falling only $3.50 since FY83. Table 5 shows a comparison for the past six years of annually negotiated prices versus average Exchange Values, which have declined at a much greater rate.

Table 5

RESULTS OF ANNUAL JAPANESE URANIUM PRICE NEGOTIATIONS COMPARED TO EXCHANGE VALUE

Fiscal Year Ending March 31	Approximate Agreed Price ($/lb. U_3O_8)	Average E.V. for Preceding Japan FY (1980-85) ($/lb. U_3O_8)	Delivery Price/ Average E.V.
1981	45.00	41.17	1.1
1982	37.75	28.63	1.3
1983	35.50	23.65	1.5
1984	33.70	19.65	1.7
1985	33.50	22.10	1.5
1986	32.00	16.44	1.9

UNITED STATES

Several NRC reactor licensing actions took place in the last few months. Middle South Utilities, Inc. received a full-power license for its Waterford plant, a 1,104-MWe PWR. Commonwealth Edison received a low-power license for its Byron Unit 1, the first of two 1,120-MWe PWRs at the site. Kansas Gas and Electric Co. received a fuel-loading and low-power-testing license for its Wolf Creek plant, a 1,150-MWe PWR. Detroit Edison also received a fuel-loading and low-power-testing license for its Fermi Unit 2. Commercial operation for all four units is expected in 1985. In addition, Diablo Canyon Unit 1 reached 100-percent power in March, and is delivering 1,100 MW to the Pacific Gas & Electric grid. An inquiry by the California Public Utilities Commission has begun to determine how much of the $4 billion plant should be allowed into the rate base.

On the negative side, the low-power license granted to Long Island Lighting Company's (LILCO) Shoreham plant (see Report 199) was revoked by the Atomic Safety and Licensing Board. The 820-MWe BWR had received NRC permission to begin low-power operation only one week before. The Board revocation was based on the NRC requirement that the plant have a safe source of backup power. An NRC licensing board had bypassed that requirement by recommending that LILCO be granted an exemption. The plant's backup diesel generators are inoperable, but LILCO had submitted a plan involving smaller generators.

LILCO's emergency plan also was rejected by a New York state court, demonstrating Suffolk County's unwillingness to grant the utility authority normally wielded by state and county police in case of emergency. It now is clear that the utility will be unable to implement any emergency plan without the cooperation of local authorities, posing yet another obstacle to Shoreham's operation.

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AMPLIFICATIONS

CORRECTION

Three errors appeared in Part 2 of the Optimum Tails Assay article in Report 196 (December 1984).

1. The incremental values of the horizontal axis on Figure 1, page 14, were printed incorrectly, resulting in a misleading curve. The correct figure is reprinted below.

2. In the Appendix to the article, beginning on page 18, the implicit equations contained two errors. In the B′ equation, the (Cost Ratio) should be divided by Y, where Y equals (0.86 + 0.7 × Tails w/o) if the VTAO charge applies. (Y equals 1 if no VTAO charge applies.)

In the S equation, one component of the denominator should be (0.86 + 0.7 × Tails w/o), instead of (0.86 – 0.7 × Tails w/o).

For clarification purposes, the entire Appendix is reprinted below, with the correct equations.

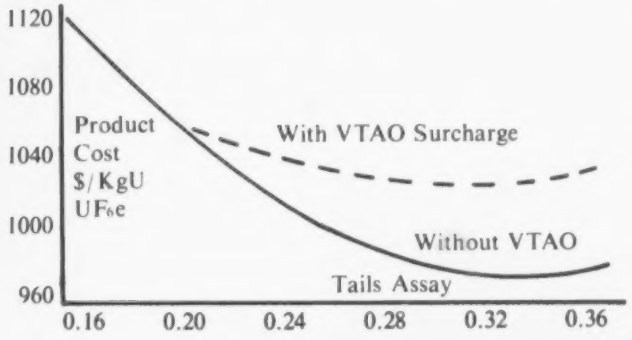

Figure 1. Cost of 3.50 w/o Product as a Function of Tails Assay for Feed at $50/KgU and Enrichment at $135/SWU.

Appendix

Tails Assay for Minimum Product Cost with Maximum VTAO Surcharge

The following series of implicit equations can be solved by iteration on a computer or programmable calculator. In this series of equations, the feed is assumed to be 0.711 w/o, and the assays are in units of weight percent, in contrast to the other equations in this article which use assay as weight fractions (weight percent = weight fraction × 100).

$$A = (\text{Tails w/o} / 50 - 1) \times (0.711 - \text{Tails w/o})$$

$$B' = 4.868883 - (\text{Cost Ratio}) / (0.7 \times \text{Tails w/o} + 0.86) + 0.985780 \times \text{Ln}[\text{Tails w/o} / (100 - \text{Tails w/o})]$$

$$S = 0.7 \times \text{SWU Factor} \times (0.711 - \text{Tails w/o})^2 / [(\text{Enrichment w/o} - 0.711) \times (0.86 + 0.7 \times \text{Tails w/o})]$$

$$\text{Tails w/o} = A \times 100 / [(100 - \text{Tails w/o}) \times (B' - S)]$$

The above relationships assume a VTAO credit for tails assays less than 0.2 w/o. As a result, they are incorrect for tails less than 0.2 w/o, and must be adjusted to the lesser of 0.2 w/o or the tails assay for minimum product cost without the credit (Report 195).

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URANIUM DEPOSITS IN THE USSR

Introduction

The USSR began developing nuclear power in the late 1940s. Recognized as a favorable alternative for electricity generation, nuclear power plants appeared well-suited for the highly populated regions of western USSR, which are far removed from natural energy resources in Siberia. Construction of the first nuclear generating plant (a 100-MWe liquid graphite reactor) began in early 1950; it was completed and operating in 1954, becoming the world's first nuclear power plant. Nuclear industry development continues in the USSR, although bureaucratic, engineering and construction problems during the mid-1960s, late 1970s and early 1980s have disrupted and delayed the program. The original construction schedule called for a generating capacity of over 50,000 MWe by 1985; actual installed capacity, however, totaled approximately 23,000 MWe at the end of 1984.

A recent announcement by the State Committee for Atomic Energy (GKAE) indicated that nuclear plant construction would be accelerated to increase generating capacity by 40,000 to 60,000 MWe in the mid-1990s, in order to accommodate an annual power growth rate of four percent. If this goal is achieved, approximately 60 percent of the USSR's electricity will be produced by nuclear energy. The program to increase nuclear generating capacity will require the expansion of all phases of the future U_3O_8 requirements, and exploration for new ore deposits along with the development of known deposits has accelerated.

Limited information concerning uranium deposits in the USSR is available from Soviet sources; that information is often limited to deposits which have been developed for industrial purposes. Soviet documentation offers geologic descriptions of certain deposits in considerable detail, while others, thought to be major deposits, are not specified. Ore reserves and percent of uranium content are never cited. Geologic setting and ore genesis are often described, indicating the wide variety of uranium occurrences. The geographic locations of most deposits usually are not described. Association by geologic setting is the principal method Western geologists use to establish location. Still, the location of certain deposits may be only approximate at best. There is even less documentation regarding ore body development and recovery technology.

The *Raw Materials* section of Report 194 (October 1984) examines uranium ores in the Zholtye Vody district of the Ukraine.

Classification of Uranium Deposits

Uranium occurrences in the USSR correspond to many known occurrences in the western world. Significant exceptions are the absence of large-tonnage Precambrian quartz-pebble conglomerates similar to the Witwatersrand Basin of South Africa and the Elliot Lake district of Ontario, Canada, and Proterozoic unconformity-related deposits in the Northern Territory of Australia and the Athabasca Basin of northern Saskatchewan, Canada. However, Soviet geologists remain optimistic that important deposits in both types of geologic environment will be discovered eventually.

Uranium occurrences in the USSR generally are classified by vein-type and hydrothermal mineralization. Vein deposits are associated mainly with intrusive and metamorphic rocks; hydrothermal deposits are associated directly with sedimentary rocks, from sandstones to shales, and coal beds. Uranium deposits are subdivided into four basic series. Each series is further divided into classes and specific types of deposit.[1]

1. The *series* of the deposit is determined by geologic position and age, as well as genetic relationship;
2. The *class* of deposit is established by mineralogy, structural form and association with surrounding host rocks;
3. The *type* of deposit depends on the local geologic features controlling mineralization. A total of 16 types of ore deposits have been described. Table 6 lists and briefly describes each type.

Conclusion

Figure 2 illustrates the location of many important uranium districts and production centers in the USSR. Uranium is produced (or has been produced) from all 16 types of deposits listed in Table 6, although the actual importance of each to the uranium supply program is unknown. Certain types of deposits have not contributed to U_3O_8 requirements, while others have served as a main supply. The principal differences between deposits are total tonnage available, contained U_3O_8, accessibility to mining, and favorable metallurgy.

[1] Kazanskiy, V. I., and Laverov, N. P., *Mestorozhdienia Urana (Uranium Ore Deposits)*—Nedra, Moscow, 1974.

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Table 6

URANIUM ORE CATEGORIZATION IN THE USSR

SERIES A. *Metamorphogenic deposits of ancient platforms.* Uranium mineralization in Precambrian basement intrusives and metamorphic rocks. Tectonic and metasomatic zones contain important vein deposits.

- Type 1. *Iron-uranium mineralization associated with sodium and carbonate-rich metasomatites.* Intrusions and folding influenced placement of ore in lower conglomerates, middle hematite-magnetite zones, and upper graphite schists and dolomitic marbles.
- Type 2. *Uranium associated with sodium-rich metasomatic rocks.* Ore minerals occur in elongated folds at basement contacts. Host rocks are the iron formation, migmatites and mylonites.

SERIES B. *Endogenic deposits of fold regions.* Ore associated with volcano-intrusive rocks in deep-seated geosynclinal fold belts.

Class I. *Hydrothermal minerals in andesites-diorites.* Uranium-molybdenum minerals in both rock types, associated with post-orogenic hydrothermal activity.

- Type 3. *Uranium associated with dikes.* Diorite dikes associated with syenite intrusives cut lower sedimentary rocks. Ore is in conglomerates, sandstones and argillites.
- Type 4. *Uranium-molybdenum ore in paleovolcanoes and related minor intrusions.* Deposits are in fold-belts of Paleozoic rocks, along faults and folds at intrusive contacts in association with altered sandstone and pyroclasic rocks.
- Type 5. *Apatite-uranium deposits in paleovolcanoes and carbonate-marine sediments.* Ore occurs in carbonate rocks interbedded with shales and sandstones; ore controlled by faulting and volcanogenic rock sequence.

Class II. *Hydrothermal deposits associated with rhyolite-granitic rocks.* Ore is concentrated in volcanogenic depressions and related fault zones; ore formed during post-volcanic hydrothermal activity.

- Type 6. *Uranium deposits in volcanic depressions.* Ore is of late Paleozoic age, occurring in rhyolite tuffs and breccias associated with caldera tectonics.
- Type 7. *Molybdenum-uranium deposits in subvolcanic intrusives.* Ore occurs along contact zones of highly fractured and faulted Paleozoic granite and quartz porphyries and intruded andesite.
- Type 8. *Molybdenum-uranium deposits in volcanic pipes and plugs.* Ore occurs in stockworks and veins in breccia and mylonite zones resulting from volcanic intrusion and accompanying subsidence of Paleozoic basement rocks.

SERIES C. *Endogenic uranium deposits of reactivated regions.* Hydrothermal uranium deposits occur in trachyte-syenite and andesite-rhyolite rocks along reactivated tectonic zones.

Class III. *Hydrothermal deposits associated with trachyte-syenite rock formations.* Important hydrothermal uranium deposits occur in sodium-rich intrusives, with thorium in subvolcanic massifs, and titanium in crystalline basement rocks.

- Type 9. *Thorium-uranium deposits in subvolcanic massifs.* Ore is associated with sodium-rich deep-seated intrusives cutting basement rocks; ore occurs in fracture and breccia zones along major faults.

(continued)

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HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	32.50	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	**15.00**											

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	**16.20**											

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U as UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	**1.00**											

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GOVERNMENT STATISTICS

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups[1] (1969=100)	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage and Salary Earners, Weekly Rates[2] (1976=100)
1983 Avg.	401.2	181.8
Oct 1983	397.5	188.3
Nov 1983	395.5	188.3
Dec 1983	399.2	188.1
Jan 1984	399.2	188.6
Feb 1984	402.5	188.5
Mar 1984	403.9	188.3
Apr 1984	404.2	196.2
May 1984	403.8	197.0R
Jun 1984	404.9	197.0R
Jul 1984	408.5	197.0R
Aug 1984	413.3	197.0R
Sep 1984	412.1	197.0R
Oct 1984	408.6R	197.0
Nov 1984	407.2	197.0

P = Preliminary R = Revised since last month

CANADA

		Wage-earner Data: Average Hourly Earnings (C$)[2]					
	Industry Selling Price Index: Manufacturing[1] (1971=100)	Uranium Mines (SIC 057)	Metal Mines* (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Metal Industries Non-ferrous[4] (SIC 296)	(SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1983 Avg.	298.8	—	—**	14.30	—	—	11.17
Dec 1983	302.9	17.84	15.11	14.66	11.86	10.60	11.51
Jan 1984	305.4	17.74	15.27	14.74	11.91	10.84	11.69
Feb 1984	306.6	17.78	15.59	14.90	12.04	10.82	11.51
Mar 1984	308.7	18.05	15.52	14.82	12.14	10.84	11.58
Apr 1984	310.5	18.06	15.83	15.10	11.96	10.34	11.63
May 1984	310.6	18.48	15.64	15.06	12.11	10.16	11.65
Jun 1984	311.0	18.08	15.48	14.80	12.38	10.40	11.66
Jul 1984	312.7R	17.81	15.72	14.92	12.53	10.18	11.82
Aug 1984	312.4R	17.24	15.36	14.92	12.44	10.34	11.78
Sep 1984	312.0	17.68	15.96	15.34	12.51	10.52	11.90
Oct 1984	312.3	17.64	16.15R	15.26R	12.69R	10.56R	11.96R
Nov 1984	313.5	18.08P	16.10P	15.35P	12.47P	10.53P	11.99P
Dec 1984	313.9	—	—	—	—	—	—

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

*The 1980 average for Metal Mines was incorrectly reported as 10.59. The correct average is 10.58 (see Report 190).

**Two different methods were used in the 1983 "Metal Mines" category in reporting survey data, and Statistics Canada did not publish a 1983 average. The March 1983 figure for the old method was 14.73 and for the new method was 14.84. The published average for 1983 in Report 190 was a Nuexco calculation based on the available monthly statistics for 1983 with the exception of the March figure, where only the 14.84 value was taken into account.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982=100)[2]	Consumer Price Index[3] (1975=100)[4]	Producer Price Index All Groups[5] (1975=100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1983 Avg.	51.87	115.0	262.2	274.8	696,579	3,644,772
Nov 1983	—	—	271.4	281.6	688,459	317,485
Dec 1983	53.70	119.6	273.2	283.7	690,750	333,595
Jan 1984	—	—	274.7	283.3	689,807	326,619
Feb 1984	—	—	278.4	286.5	702,553	335,906
Mar 1984	55.30	123.1	281.9	288.0	715,628	342,332
Apr 1984	—	—	286.1	290.2	712,963	327,550
May 1984	—	—	288.3	292.6	710,040	327,937
Jun 1984	56.95	126.2	291.2	295.3	717,009	347,121
Jul 1984	—	—	295.1	296.0	717,121	369,964
Aug 1984	—	—	297.0	300.8	721,905	361,357
Sep 1984	60.64	133.2	299.9	304.1	721,470R	359,218
Oct 1984	—	—	303.7	308.7	717,865	363,755
Nov 1984	—	—	307.4	312.8	—	—
Dec 1984	—	—	309.4	—	—	—

UNITED STATES

	Producer Price Index[1]		Consumer Price Index[2]	GNP Implicit Price Deflator[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
	Industrial Commodities (1967=100)	All Commodities (1967=100)	(1967=100)	(1972=100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1983 Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
Nov 1983	318.3	305.5	303.1	—	12.64	13.56	10.86	8.77
Dec 1983	318.4	306.1	303.5	218.53	12.75	13.33	10.90	8.84
Jan 1984	319.1	308.0	305.2	—	12.67	13.38	10.91	8.88
Feb 1984	320.6	308.9	306.6	—	12.81	13.34	10.90	8.86
Mar 1984	321.9	311.0	307.3	220.58	12.85	13.33	10.95	8.88
Apr 1984	322.5	311.4	308.8	—	12.91	13.30	10.97	8.89
May 1984	323.3	311.7	309.7	—	12.99	13.37	11.02	8.89
Jun 1984	323.9	311.4	310.7	222.40	12.96	13.40	11.03	8.91
Jul 1984	324.0	312.0	311.7	—	13.02	13.36	11.12	8.95
Aug 1984	323.5	310.9	313.0	—	13.10	13.51	11.13	9.00
Sep 1984	322.3	309.5	314.5	224.36	13.20	13.39	11.23	9.08
Oct 1984	323.2	309.4	315.3	—	13.23R	13.53	11.32R	9.09R
Nov 1984	323.8	310.4	315.3	—	13.23	13.76	11.35R	9.15R
Dec 1984	323.0	309.9	315.5	225.90	13.21P	13.65P	11.35	9.26
Jan 1985	—	—	—	—	—	—	11.37P	9.33P

P = Preliminary R = Revised since last month

For annual averages prior to 1983, and for notes pertaining to these statistics, see pages 23-26 of Report 190 of June 1984.

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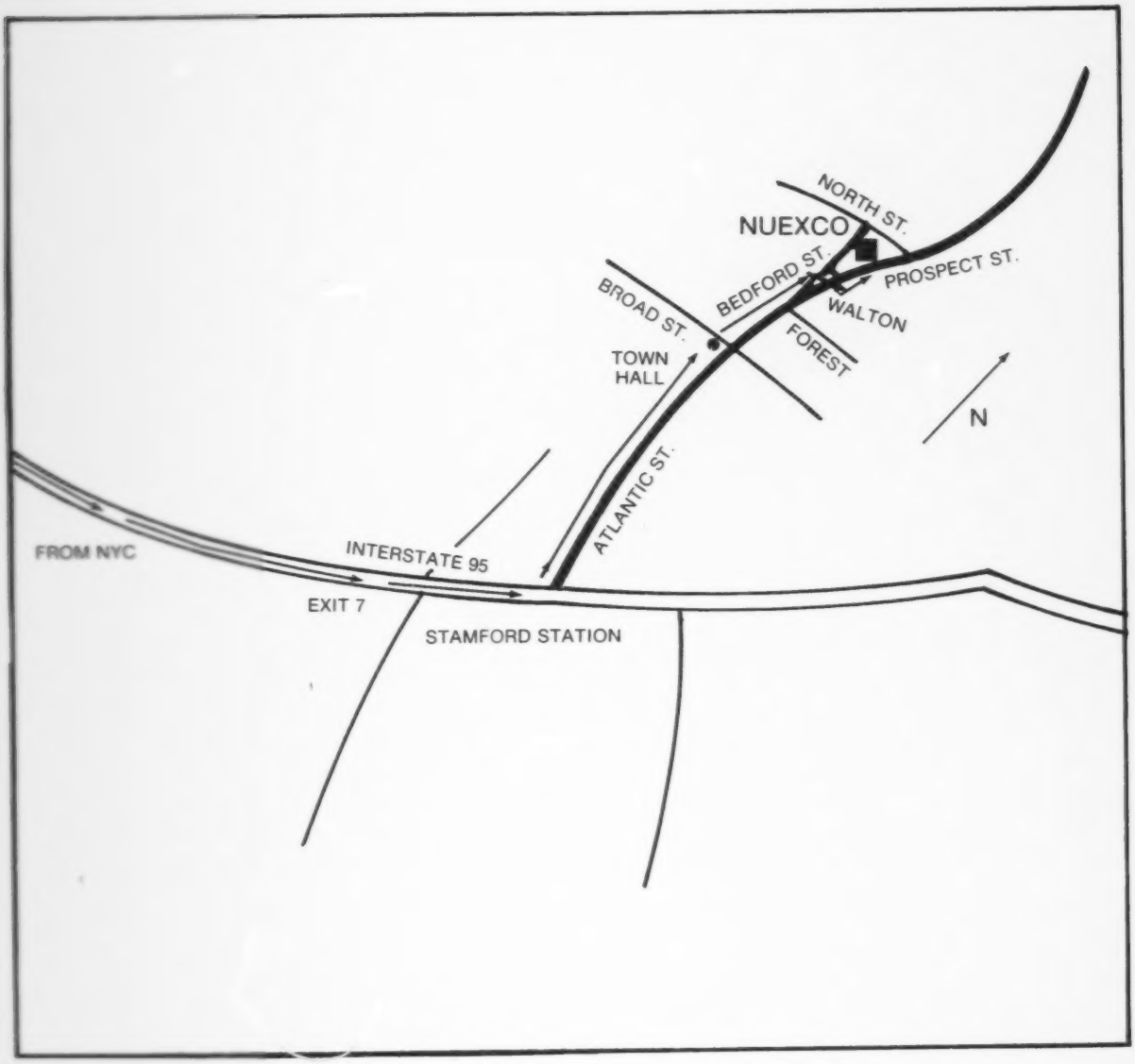

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After the second light, take a right onto Walton Place.
At stop sign, take a left onto Prospect Street. Our parking lot (underground) is located at 100 Prospect Street.

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